for example, we consider that not everything is well with scientific criticism. Up to the present the scientific works published by the Institute have not always been subjected to painstaking and deep critical consideration.

I should like to avail myself of my being on the rostrum of the Conference to say a few words in regard to conditions in the Leningrad Polytechnic Institute, of which I am a professor. There is no doubt that the Polytechnic Institute is of tremendous importance for the preparation of our technical personnel.

In spite of the fact that the Polytechnic Institute is one of the oldest schools of higher technical education and that it prepares an enormous number of specialists in the most varied fields, its laboratory basis is in a difficult position. For several years past the laboratories of the Polytechnic Institute have been built up very little and the result is that the new technique created in the Soviet Union during the past decade is very poorly represented in the laboratories of the Institute.

The buildings of the Institute are in bad condition; some of them have not yet been repaired.

The Polytechnic Institute takes an active part in the development of Soviet science and technique, and strengthens its bond with production, but it could do incomparably more if its material basis were given more attention.

It seems to me that in this respect we are entitled to expect that the City Committee of the Party will give attention to the situation of the Institute and will help us to achieve a substantial change of conditions.

Comrades! Soviet physics, particularly during the last ten years, has proven its might. No one can have any doubt now that our physics is in the true meaning of the word an advanced science. Even if some shortcomings are found, even if there are some scientists who allow some errors, still that can in no wise define the countenance of our Soviet physics, and the fact that our physics is in the true meaning of the word an advanced science is proven by the record speed with which it solves problems which have great significance for the economy of the country.

Soviet physicists, like all Soviet scientists, understand and appreciate the care of the Party, and the care of the greatest scientist of our epoch, our leader and teacher, Comrade Stalin. And we fully comprehend that it is exactly for the reason that we are guided by such a genius of humanity as is Iosif Vissarionovich Stalin, that Soviet scientists and technicians have succeeded in so rapidly creating new and advanced techniques.

I think that I express the thoughts and desires of all our Leningrad physicists if I declare that the Soviet physicists will be in the future, as heretofore, among the first ranks of the creators of the new Soviet technology, which will many times amaze the whole world with the greatest attainments. These achievements will help us in a very short time to complete the building of Communist society in our country.

To him, to the leader of peoples, to Comrade Stalin of the great Party of the Bolsheviks we are grateful for those unusual conditions for the development and growth of Soviet science which now exist in our country. (Applause.)

Books

Communication Theory

THE MATHEMATICAL THEORY OF COMMUNICATION. **By Claude E. Shannon and Warren Weaver. 117 pp. University of Illinois Press, Urbana, Illinois, 1949. $2.50.**

Some fifteen years ago, a very bright young student came to the authorities at MIT with an idea for a theory of electric switching dependent on the algebra of logic. The student was Claude E. Shannon, now of the Bell Telephone Laboratories, and his idea has blossomed into a career of studying communication from the point of view of switching. In this, his scope has taken him from one side of communication engineering to the other, although always with a point of view favoring the discrete rather than the continuous. Together with Warren Weaver of the Rockefeller Institute, Dr. Shannon has summed up his views on communication engineering in the book I am at present reviewing.

The first part of the present book represents the development by Dr. Shannon of a theory of the measurement of communication and of the amount of information both in the presence of noise and in its absence. The fundamental idea dominating the work is that of the amount of information as negative entropy. This idea was also developed at about the same time by the author of the present review, but against a background in which continuous communication theory played a more direct role, and discrete communication theory a less direct role than in the work of Shannon.

The second part of the book is a comment by Dr. Weaver on the present state of communication theory, and on the nature of communication channels. It is more philosophical and less concrete than the work of Dr. Shannon, but fills an important place in the literature. The general rise of the theory of communication during the war occurred in more than one quarter subject to the sympathetic direction of Dr. Weaver, and it is an excellent thing to see his continued interest in the philosophical side of the projects he directed. The net result of the work by Drs. Shannon and Weaver (a work whose origins were independent of my own work, but which has been bound from the beginning to my investigations by cross influences spreading in both directions) is that the theory of communication is a branch of statistical mechanics. Thus the inability of a system of communication to produce in the end more recoverable information than has gone into it is a part of the theory of the second law of thermodynamics. This appears in the beginning to be rather a forced analogy, but to those of us who have tried to pursue this analogy into the study of the Maxwell Demon, it is much more than that, and is a clear statement of physical rather than purely intellectual identity. This larger field is one in which much work re-

mains to be done, and in which we hope we shall see contributions in the future from the authors of the present book.

Besides the strictly mathematical assessment of the communication power of several modes of communication the book stresses the nature of language in communication. Here a complete treatment of human language would seem to me to involve a greater emphasis on stages of communication within the human nervous system than a casual reading of the book would indicate. Language is a matter in which the crude nonhuman measurements fail to give an adequate account of the tremendous losses of information inseparable from nervous reception and the transmission of language into the brain. I say these things not as a hostile criticism, but as comments in the spirit of the authors themselves on fields of study, namely linguistics, which I think the future will show to lie well within the purview of the communication engineer.

The present book like my own *Cybernetics* represents a first essay in a field which promises to be well documented within a few years, and its level is of a high degree of simplicity. In my book, I have taken the privilege of an author to be more speculative, and to cover a wider range than Drs. Shannon and Weaver have chosen to do. I wish to repeat that in a new subject it would be a shame if all the authors followed the same thought, and that there is not only room, but a definite need for different books which vary widely in their degree of concreteness on the one hand, and in speculativeness on the other. I salute my colleagues in having written a well worked and intellectually independent approach to the problems of cybernetics.

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Luminescent Solids

INTRODUCTION TO THE LUMINESCENCE OF SOLIDS. **By Humboldt W. Leverenz. 569 pp. John Wiley and Sons, Inc., New York, 1950. $12.00.**

Among the recent books on luminescence, Leverenz's volume is characterized by an effort to correlate the vast amount of technical information obtained in the rapid development of applications—like television, radar, and fluorescent lighting—with the more slowly progressing fundamental investigations. An introductory 50-page text on physics, chemistry, and crystallography, from which the subject of luminescence is supposed to be developed, is followed by a commendably explicit discussion of phosphor syntheses and by chapters on constitution and energy levels and on the luminescence process. A "resumé of useful phosphors" (describing many of their properties) forms the transition to a chapter on practical applications. Both theory and experiments are presented mainly in the form of a collection of material, loosely organized with the help of some "simplifying demarcations" and "outstanding general features". Repetition with minor variations is frequent, but apparently deliberate, and some subjects are treated in unexpected places. Aspects of practical importance are dealt with clearly and competently, not only in the final chapter but throughout the book.

The author's fondness for broad and sweeping surveys, apparent in many of his earlier publications, has induced him to include a good deal of material which will be considered irrelevant by most readers. Few will profit by a definition of Avogadro's number, by a tabulation of the properties of electrons, photons, neutrons, and protons or by an enumeration of nuclear forces. Leverenz's aptitude at condensation and graphic expression is far more usefully employed in his exposition of current theories, both generally accepted and controversial ones. His presentation of the former, though often in unconventional terms, seems perfectly sound, and the discussion of the latter includes some highly enjoyable common sense criticism of too flexible models and of untenable generalizations, and it maintains a healthy skepticism with few exceptions. In his preface, the author explains that "history is generally omitted" because it would be "tedious and confusing to the uninitiated". History may not be desirable in a book of this type, but the reason given is flimsy. History could certainly be interesting and revealing —that depends entirely on the historian; but as seen from the author's point of view, the history of luminescence looks as follows:

"During the alchemical infancy and haphazard growth of the phosphor art, the resultant desultory and greatly dispersed literature on luminescence of solids has become cluttered with confused terminologies, incorrect data, and baneful misconceptions. As an antidote, this book attempts to be objective, to provide a rational terminology, and to furnish a critical guide to the general literature."

This is just about what nearly every book on luminescence has tried to achieve in the past forty years, and most (not all) of their respective authors have regarded their work as the end of the period of baneful misconceptions. So did, for example, the great—though fallible—pioneer in the field, Philipp Lenard, with whom Leverenz shares also the sharp distinction made between experiments originating or repeated in one's own laboratory, and others. The still unsatisfactory definition of many phosphors gives a good deal of justification to such an approach, but in many places Leverenz carries it to absurd extremes. Details of this part of recent history would be, indeed, both tedious and revealing. The enormous list of recent references to hundreds of authors turns out to be no guarantee of a fair presentation of their work, and the "guide to the literature" leads in too many cases to quite unnecessary detours. Altogether, this reviewer finds few statements which he believes to be definitely wrong, but many which he considers seriously misleading. However, in as unsettled a field as phosphorescence, this is neither surprising nor a serious criticism.

Leverenz's book is certainly a most welcome complement to the recent volumes by Kroeger, Pringsheim, and Garlick. Containing, as it does, a large amount of information not easily found elsewhere, it will be useful to everyone seriously interested in the luminescence of solids, provided that he applies to the book itself the author's injunction that "Those who intend to become active in the